

Optical surveys of clusters of galaxies

Masamune Oguri

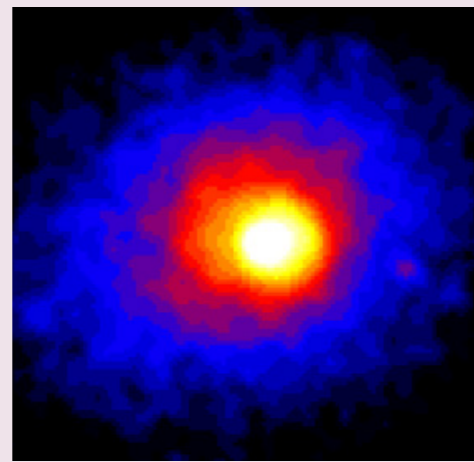
(Center for Frontier Science, Chiba U.)



Searching for cluster of galaxies

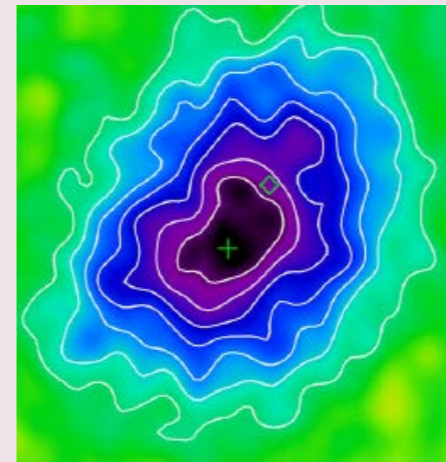


galaxy



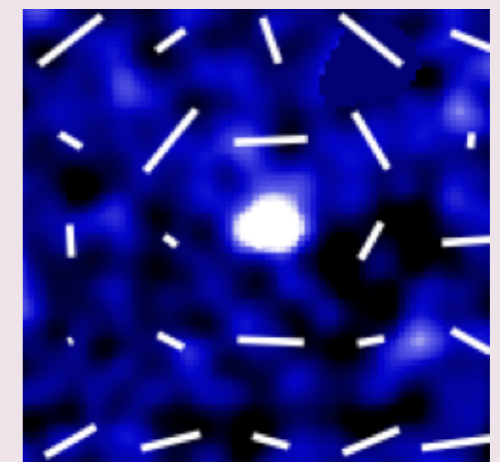
Suzaku

X-ray



Kitayama+2016

SZ



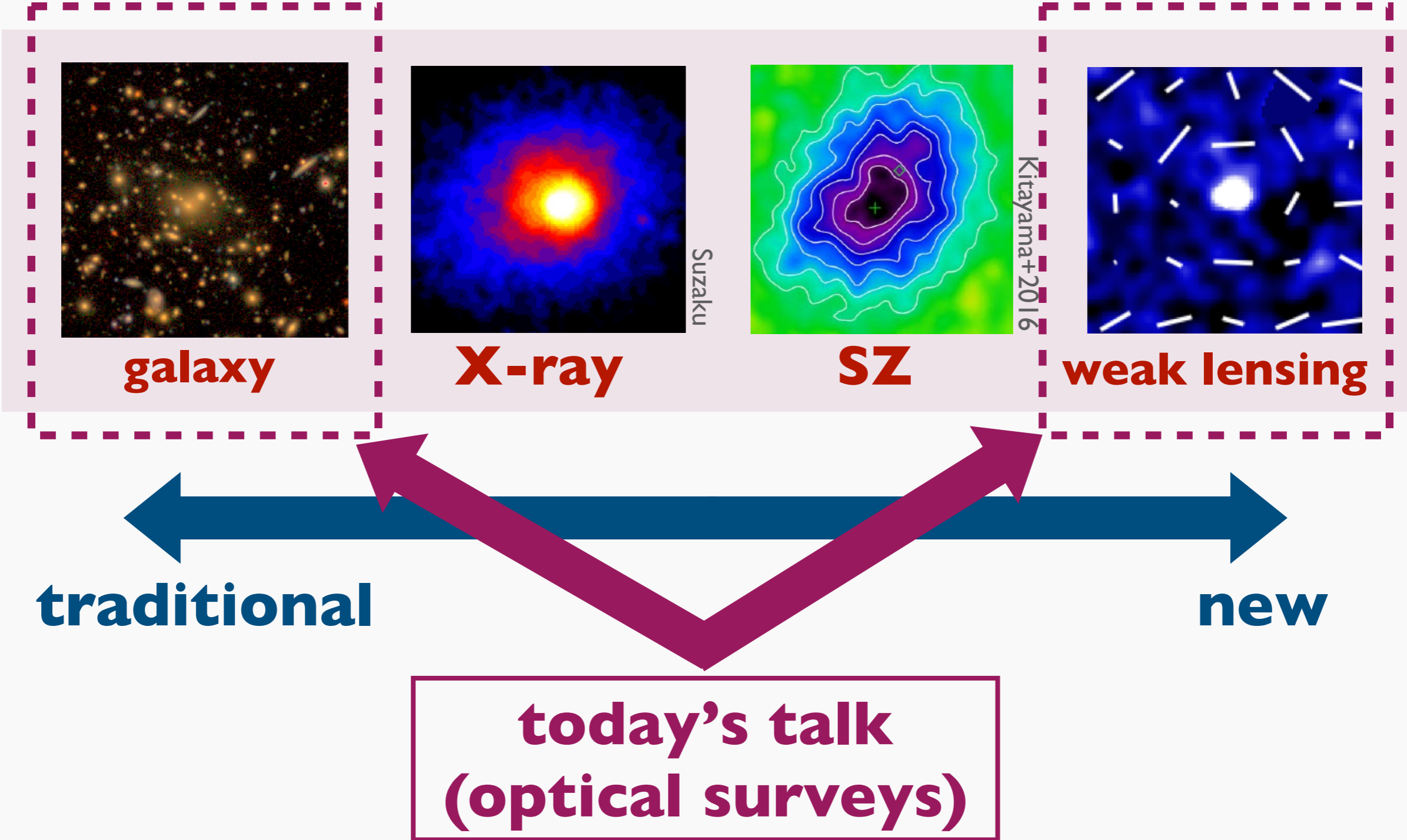
weak lensing



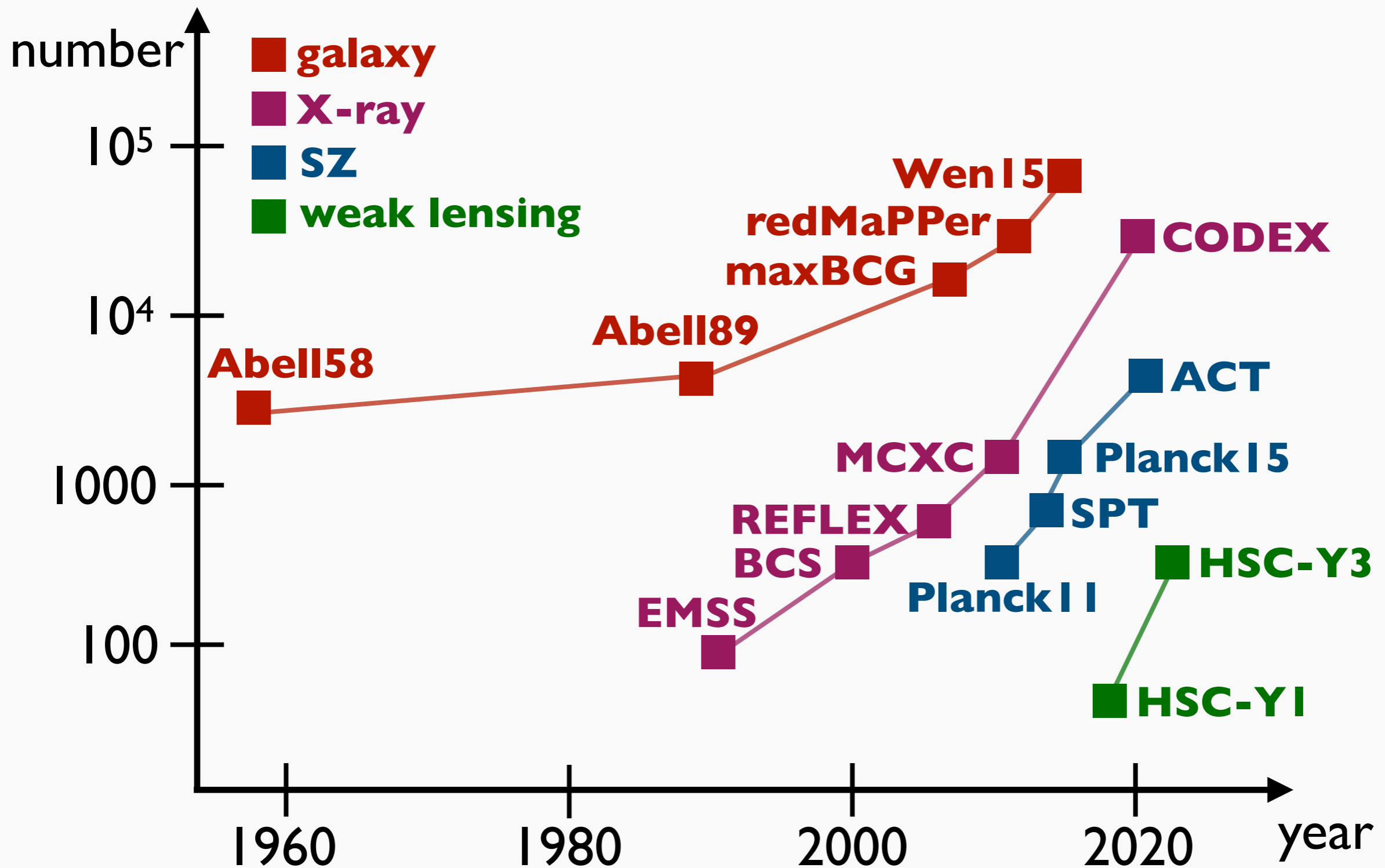
traditional

new

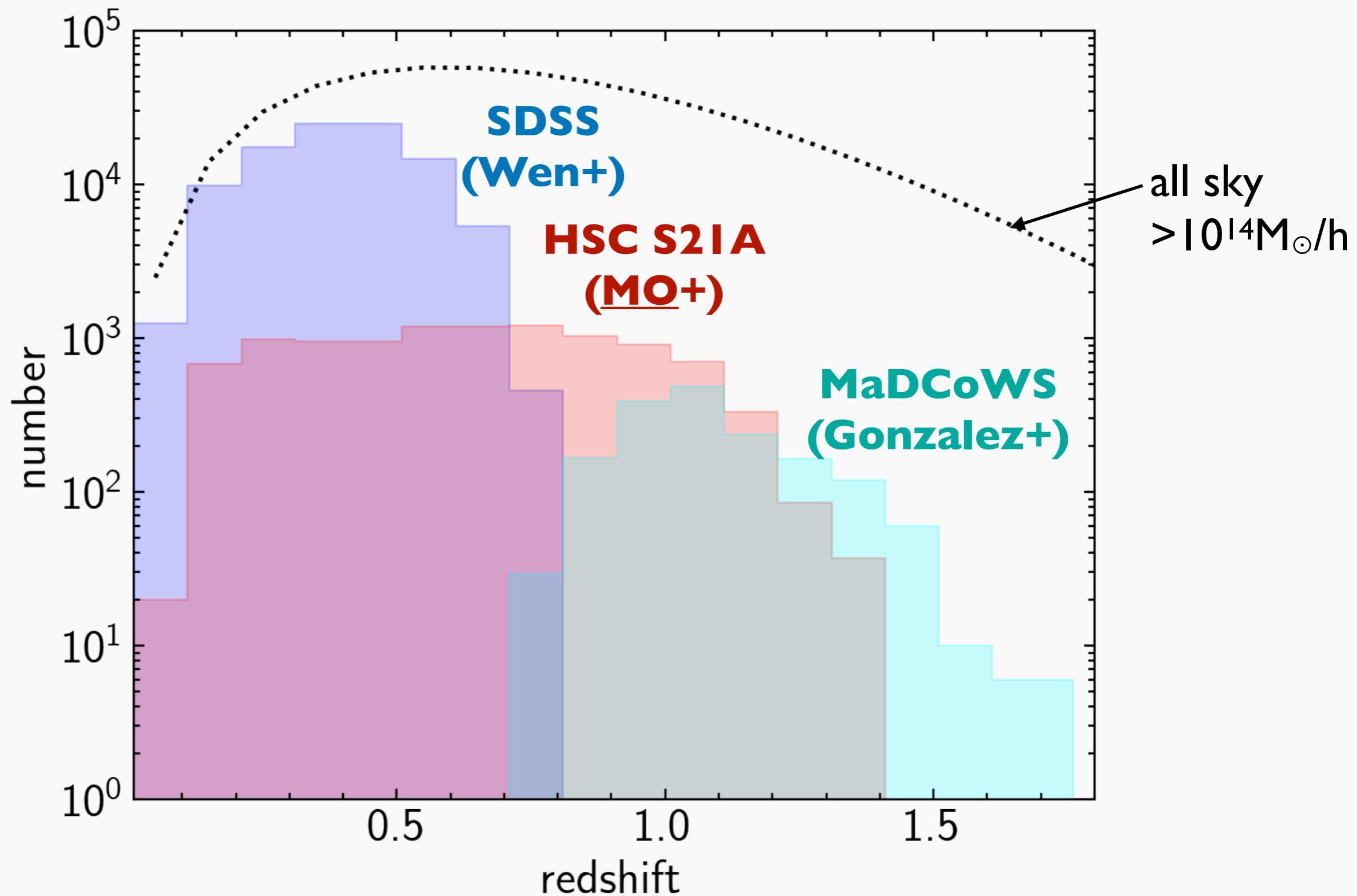
Searching for cluster of galaxies



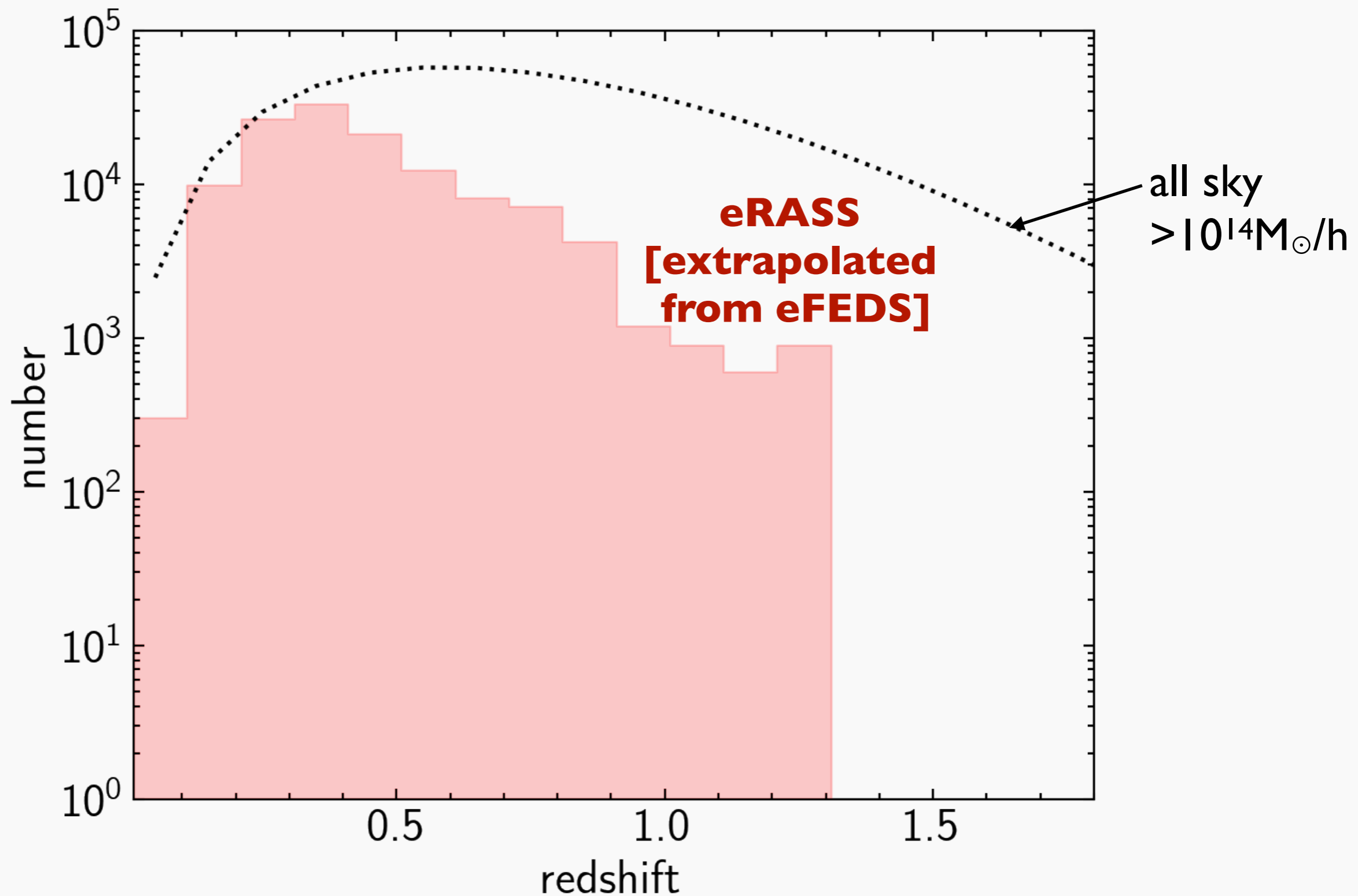
Cluster samples: history



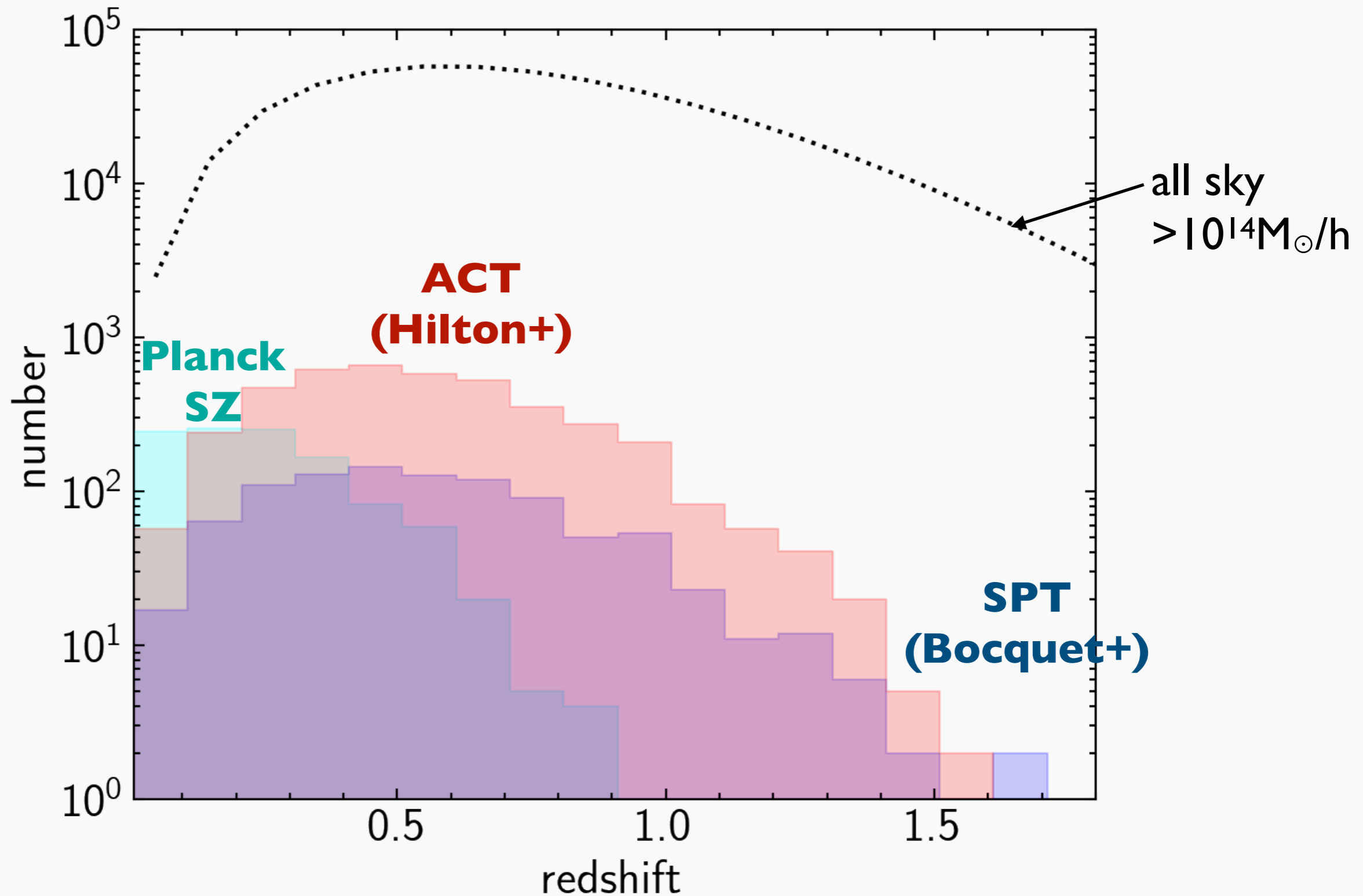
Galaxy-selected clusters



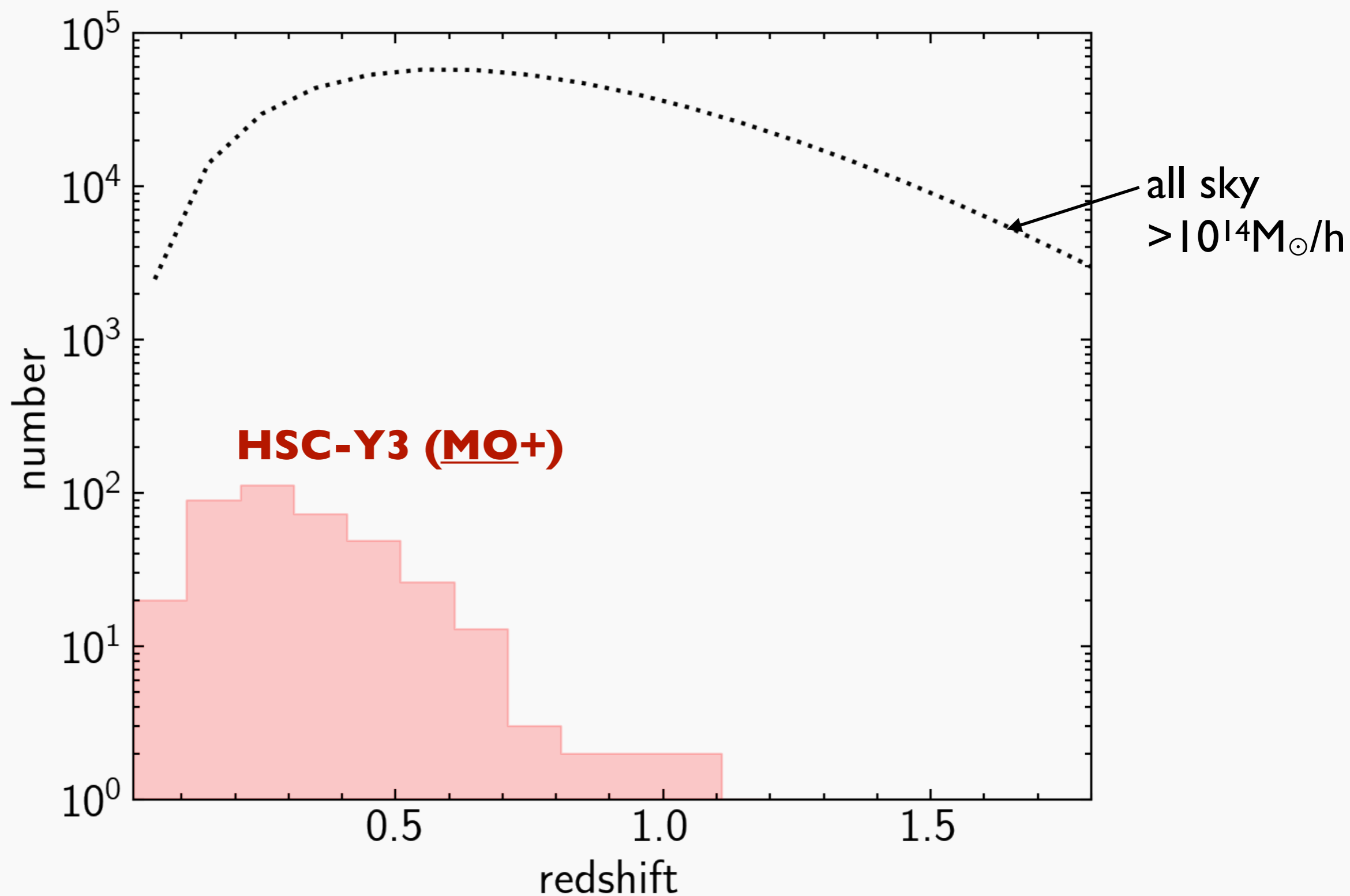
X-ray-selected clusters



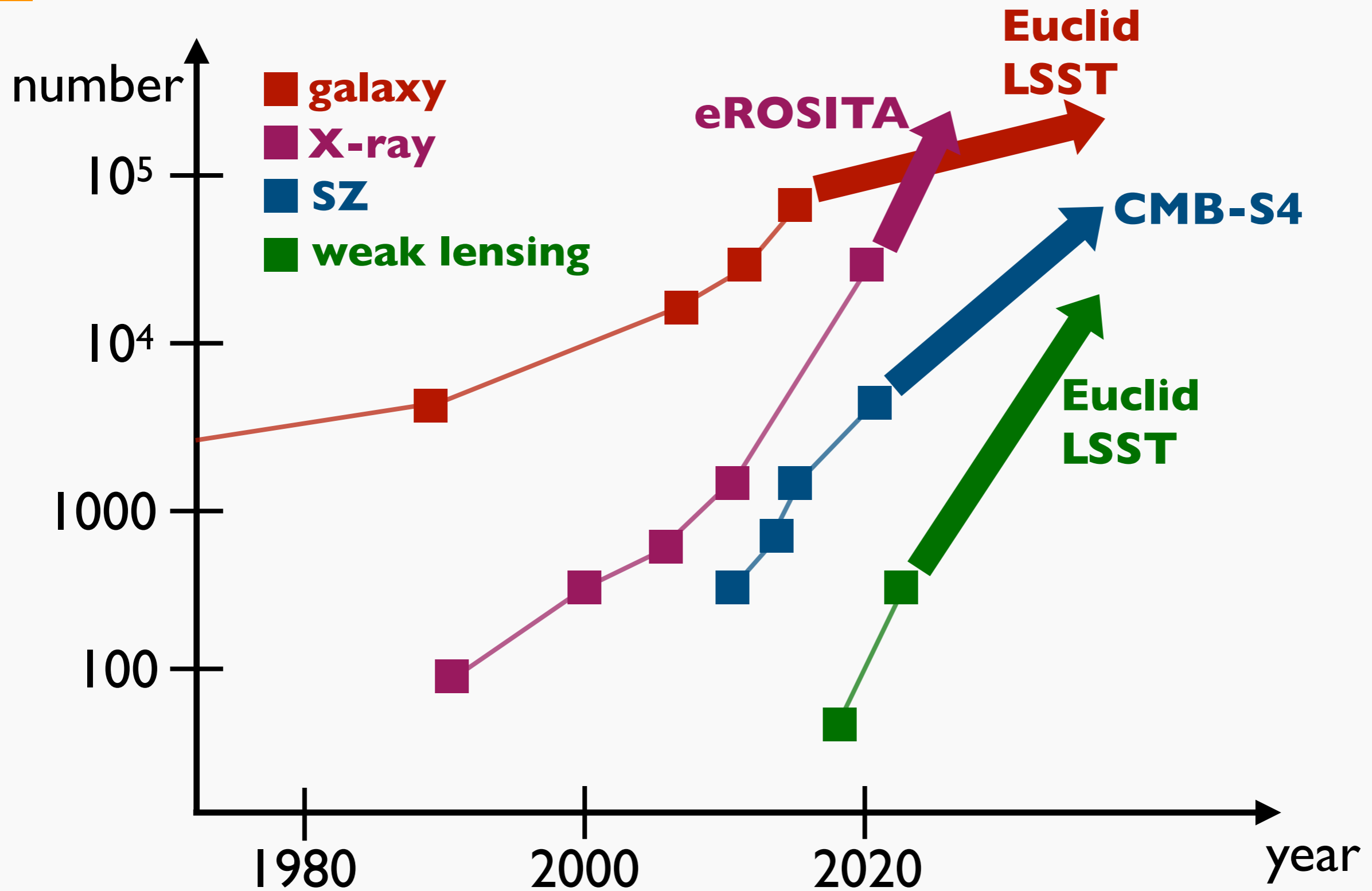
SZ-selected clusters



Weak-lensing-selected clusters



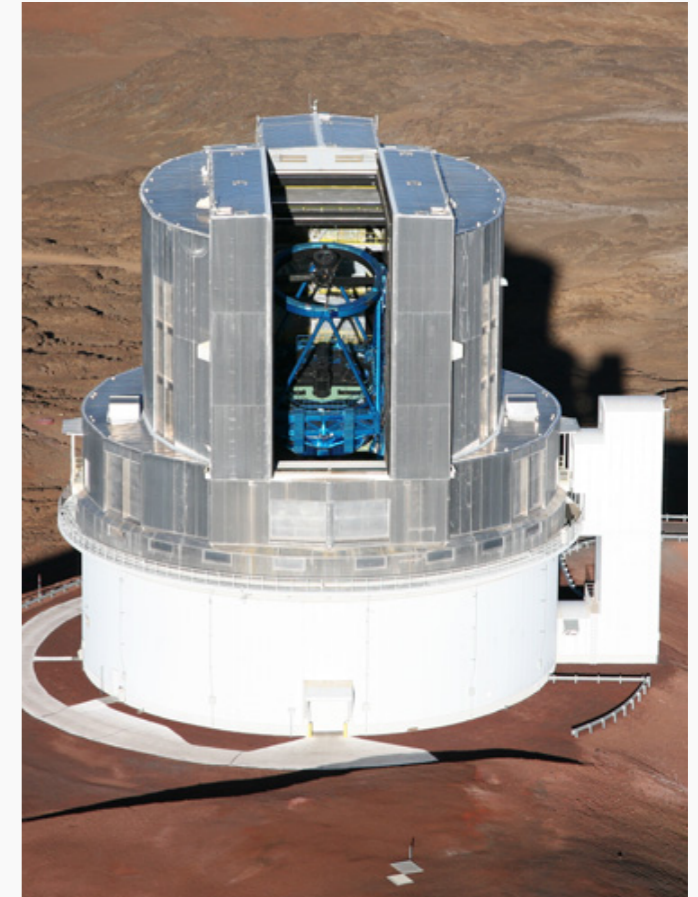
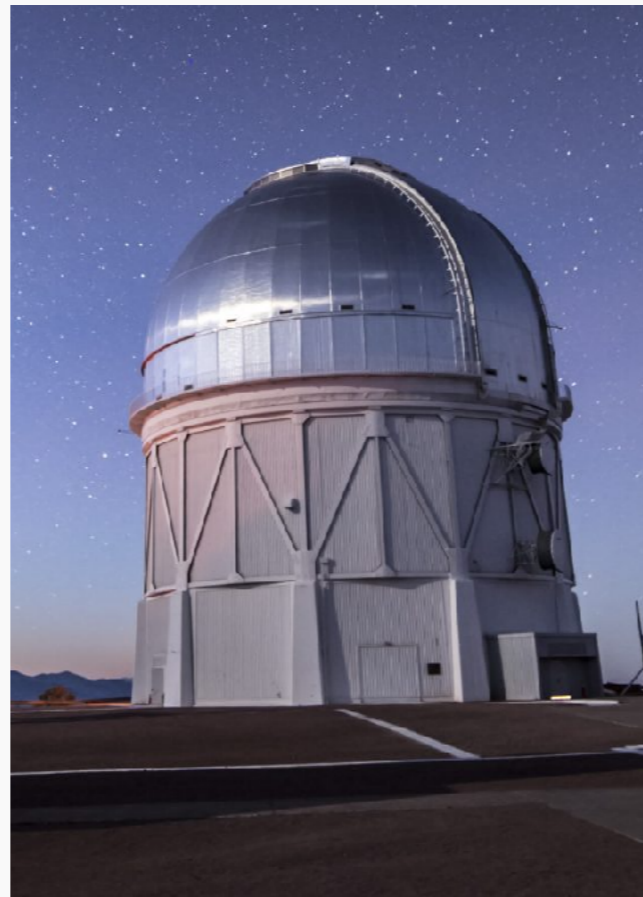
Future prospect



also talks by **Yen-Ting Lin**
and **Michael Strauss**

Subaru HSC-SSP survey

- one of stage-III dark energy surveys

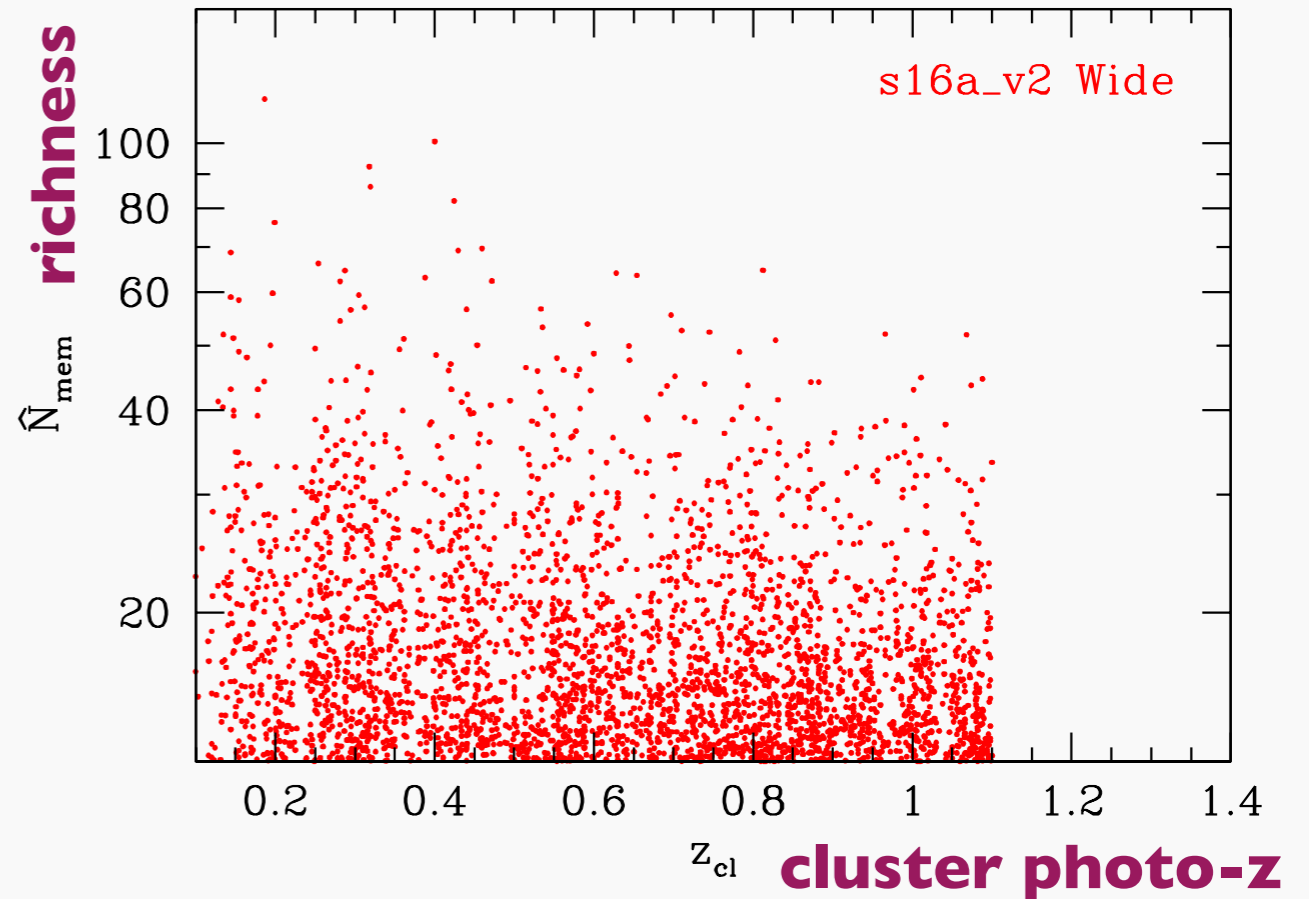
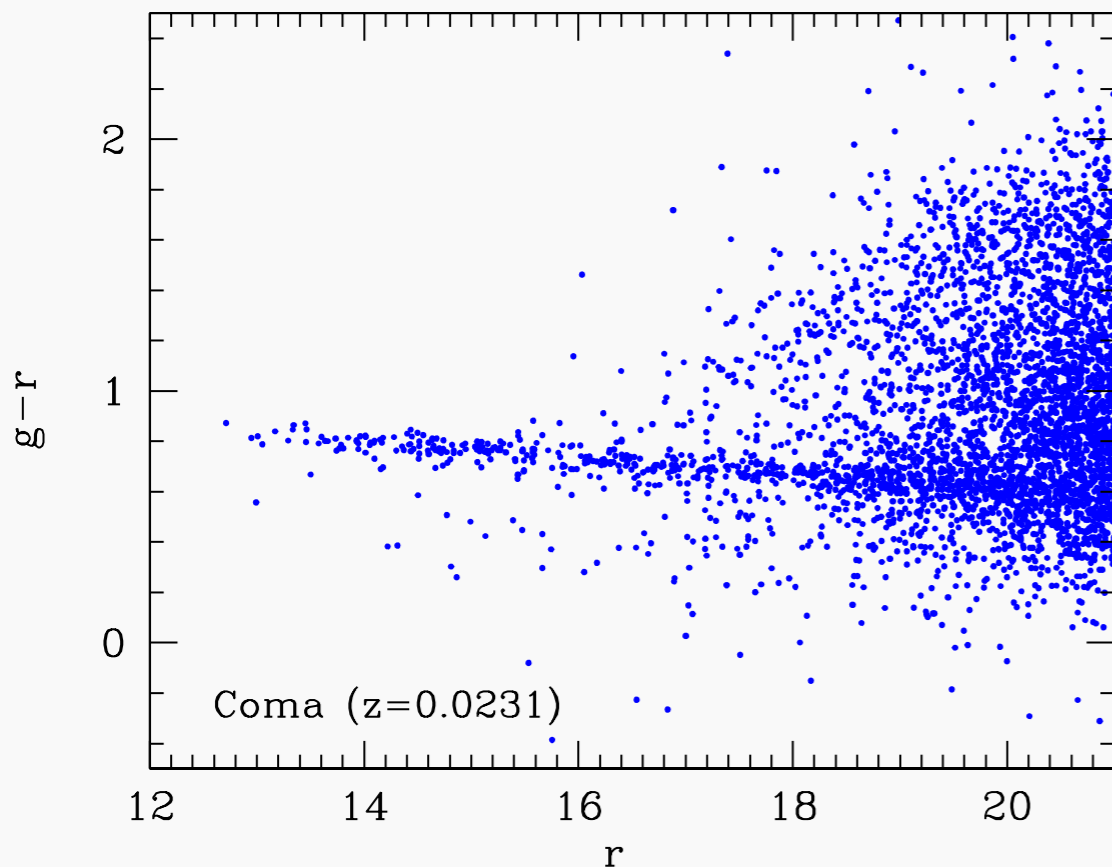


KiDS (2012-2019)
1500 deg², $r_{\text{lim}} \sim 25$

DES (2013-2019)
5000 deg², $r_{\text{lim}} \sim 25$

HSC (2014-2021)
1400 deg², $r_{\text{lim}} \sim 26$

CAMIRA cluster finding algorithm

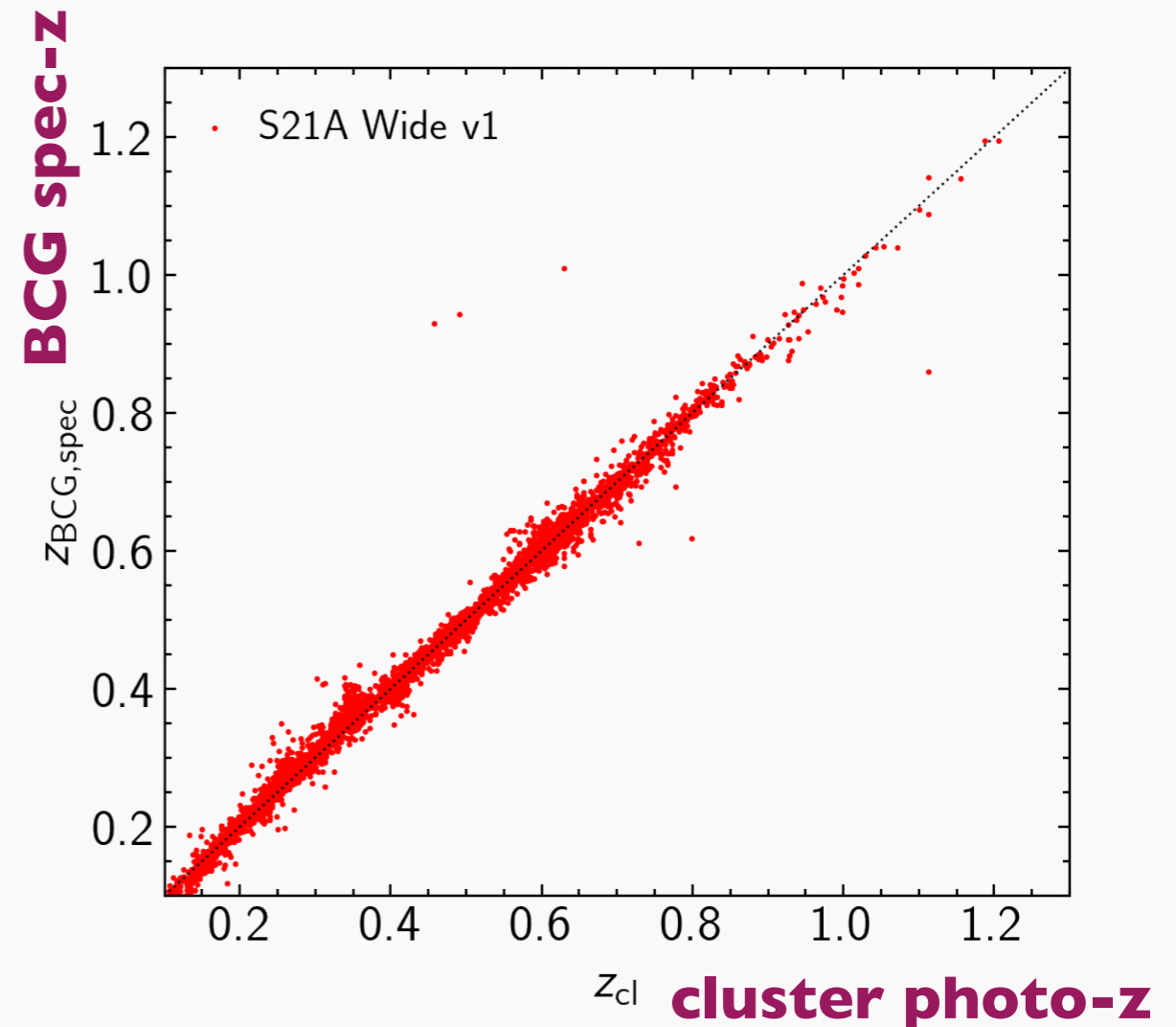
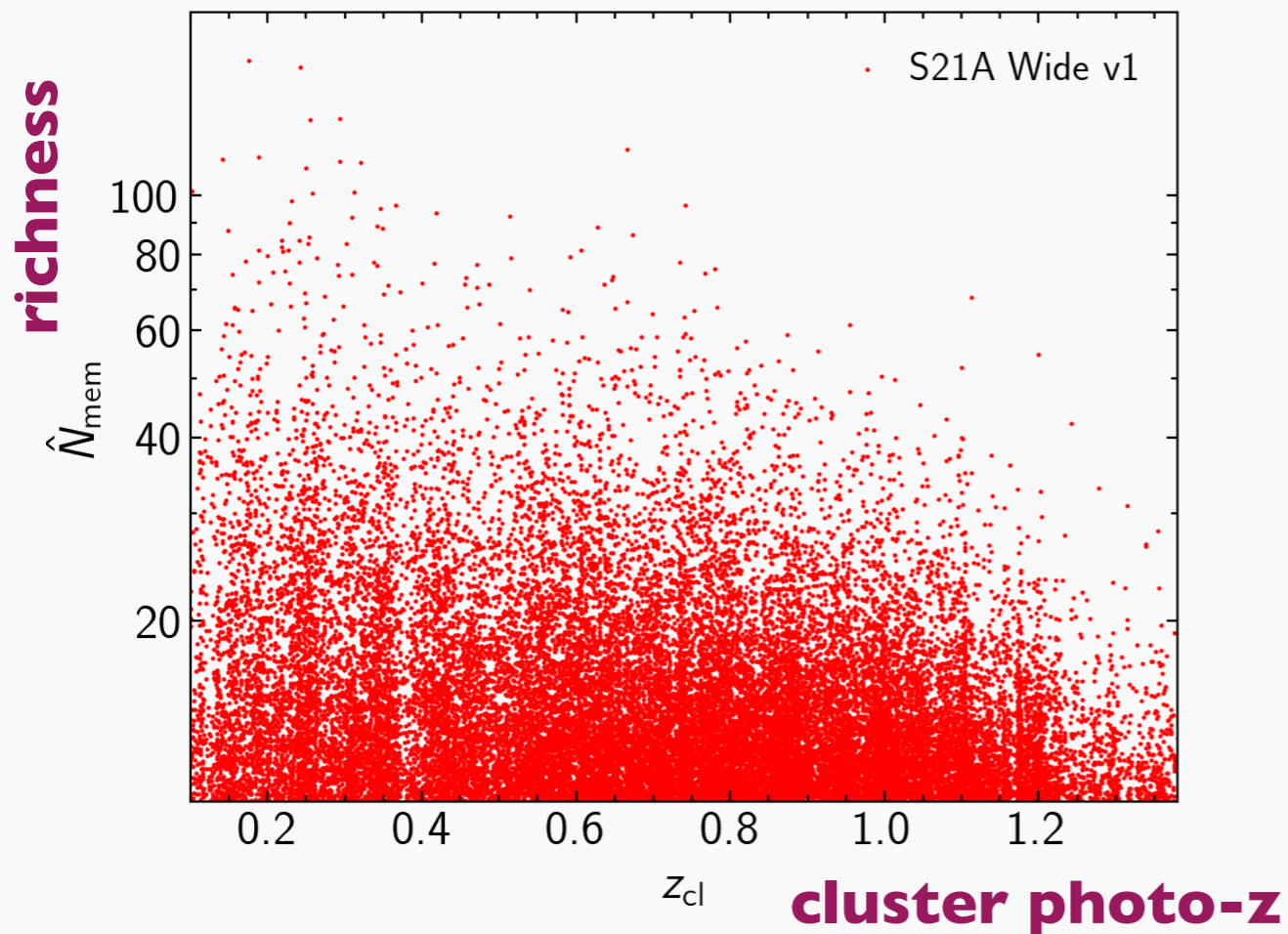


red-sequence
(find cluster, photo-z)

1921 optical clusters
at **$0.1 < z < 1.1$**
from **HSC-SSP Y1**
(**$\sim 200 \text{ deg}^2$**)

Latest HSC-SSP cluster catalog

(~1090 deg²)



10281 optical clusters
at **0.1 < z < 1.38**

photo-z accuracy
 $\sigma_z / (1+z) \sim 0.01$

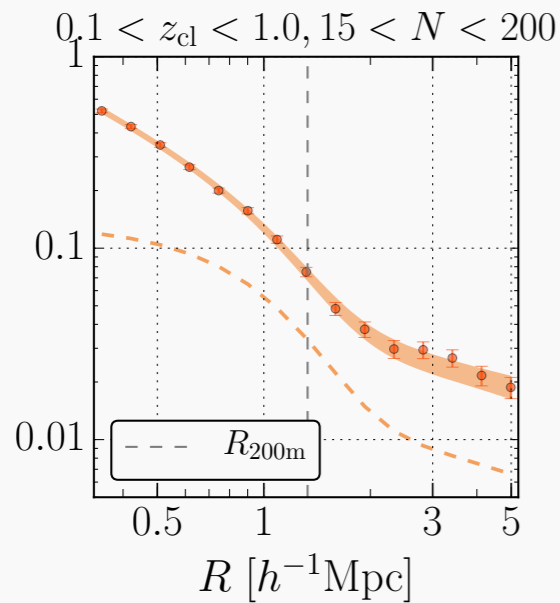
wide range of applications!



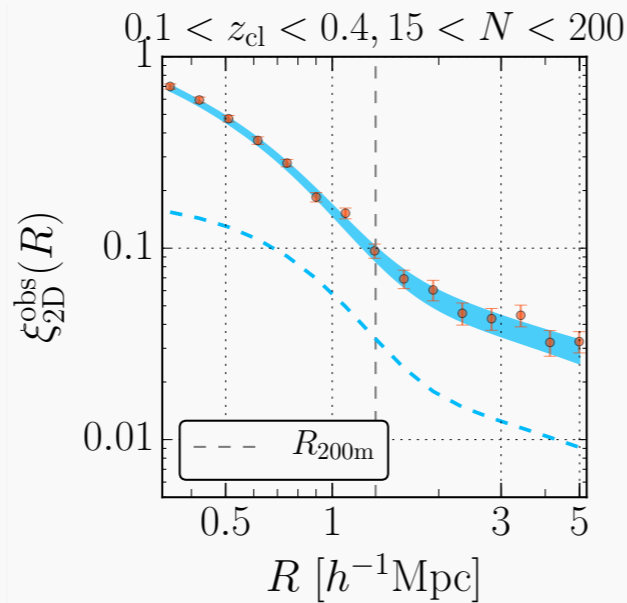
Splashback radius

cluster-gal 2PCF

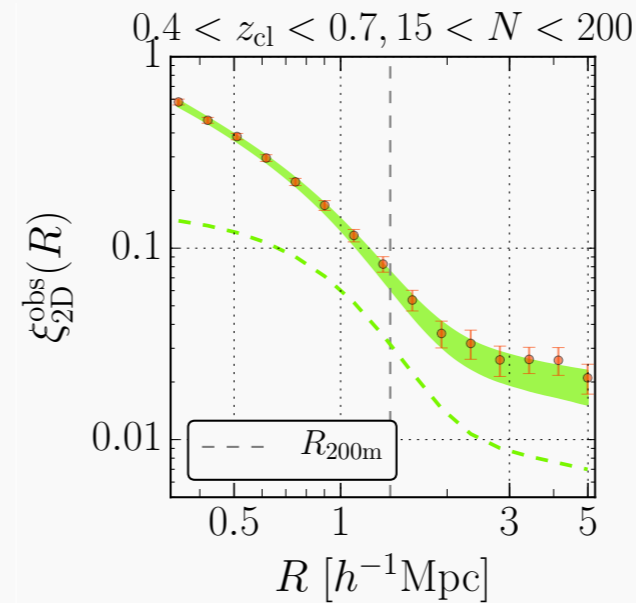
all z



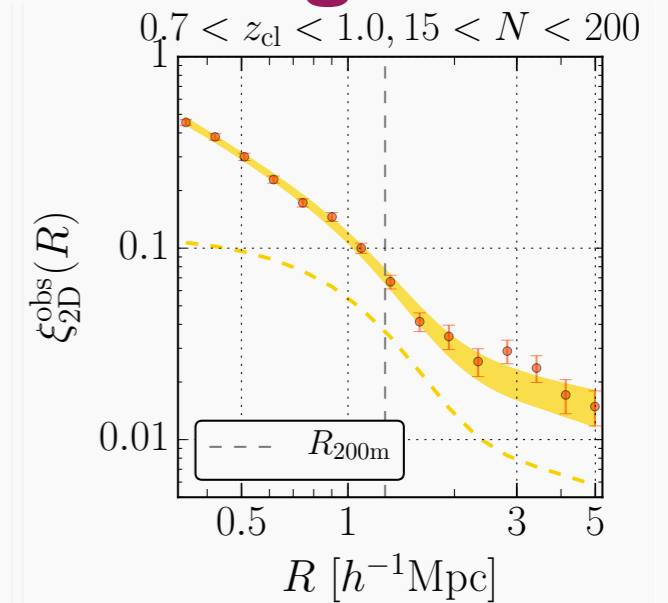
low-z



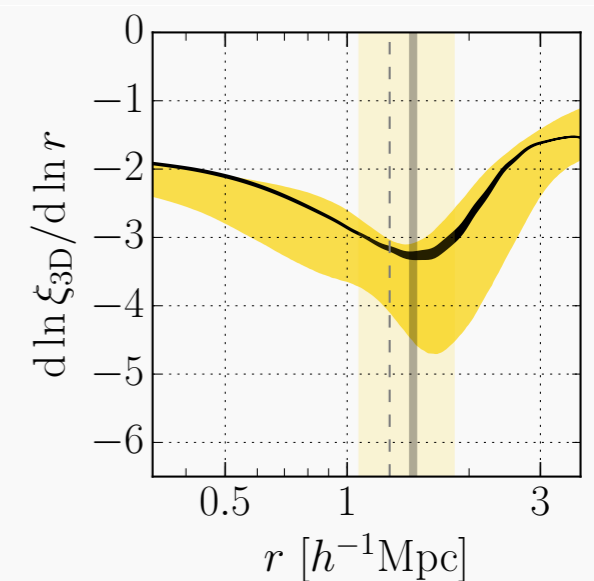
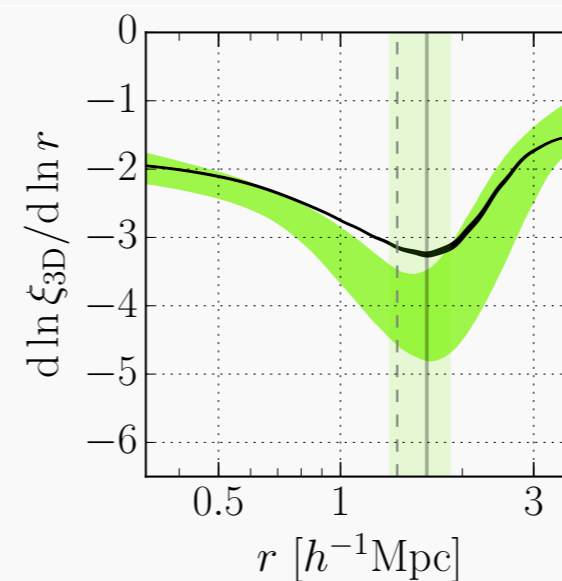
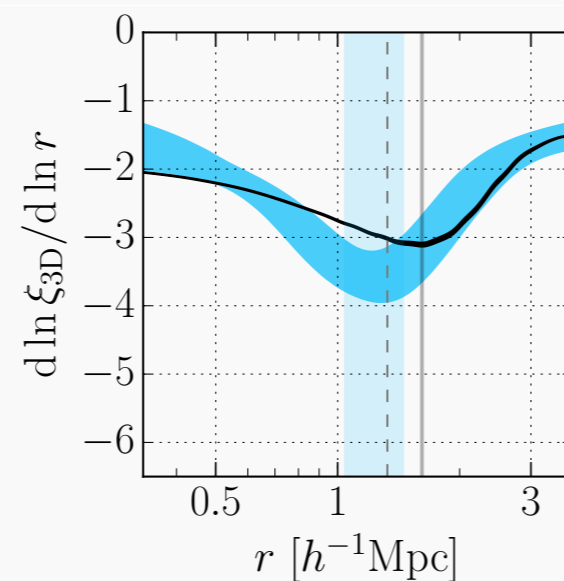
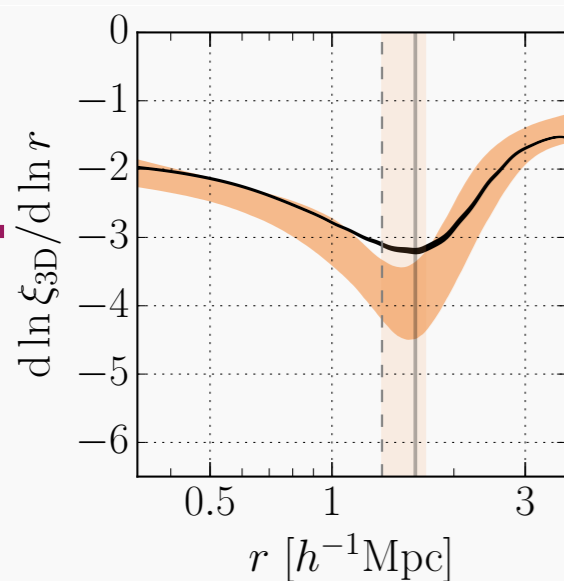
mid-z



high-z



slope



- detection at highest-z!
- consistent w/ theoretical prediction (cf. More+2016)

Public release

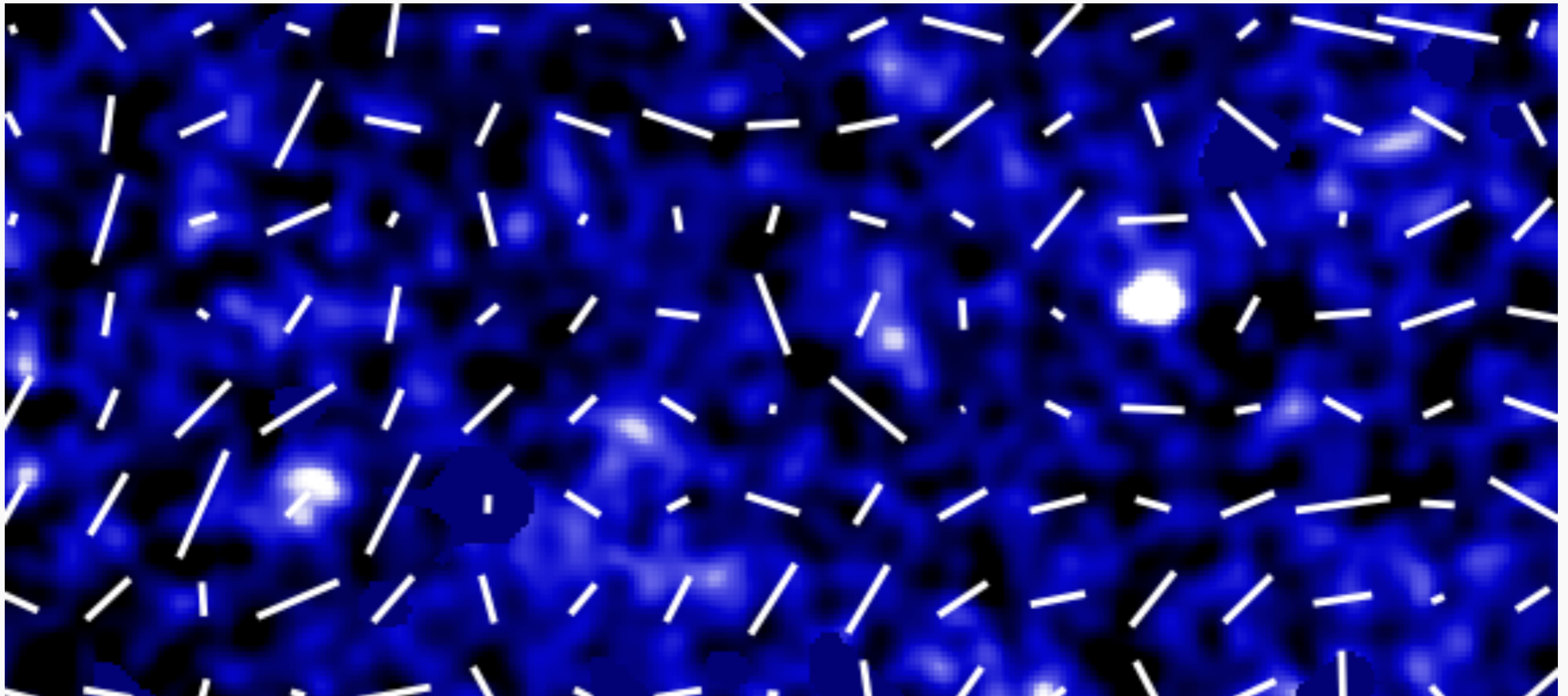
- CAMIRA cluster catalog in HSC-SSP PDR3 (~800 deg²) was released in 2022 March

https://hsc-release.mtk.nao.ac.jp/doc/index.php/camira-cluster-catalog__pdr3/

- if you are interested in a large homogenous cluster catalog out to $z \sim 1$, please check!

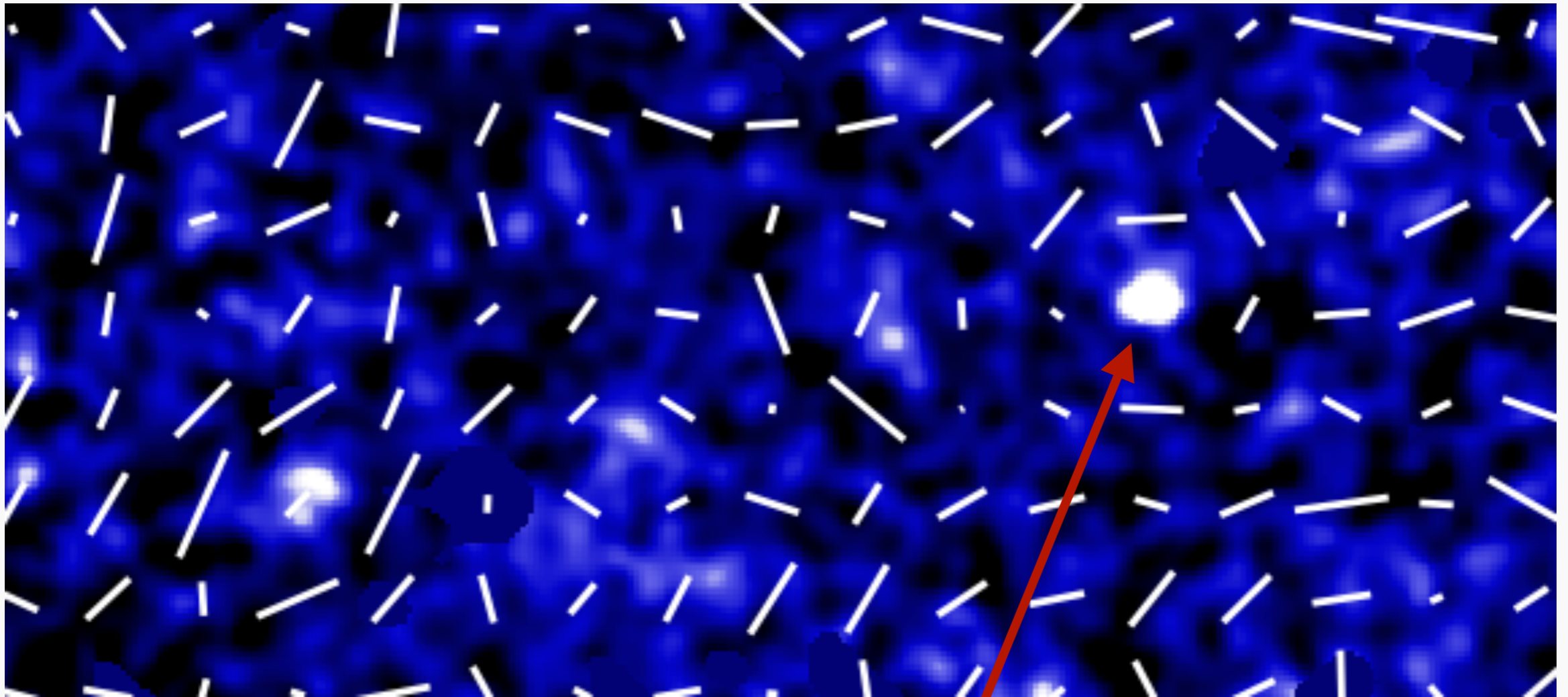
(e.g., poster by **Roohi Dalal** for BCG study w/ CAMIRA)

WL mass map



bars: observed galaxy distortion (shear)
color: reconstructed mass map
(e.g., Kaiser & Squires 1993; Schneider 1996; ...)

WL selected clusters

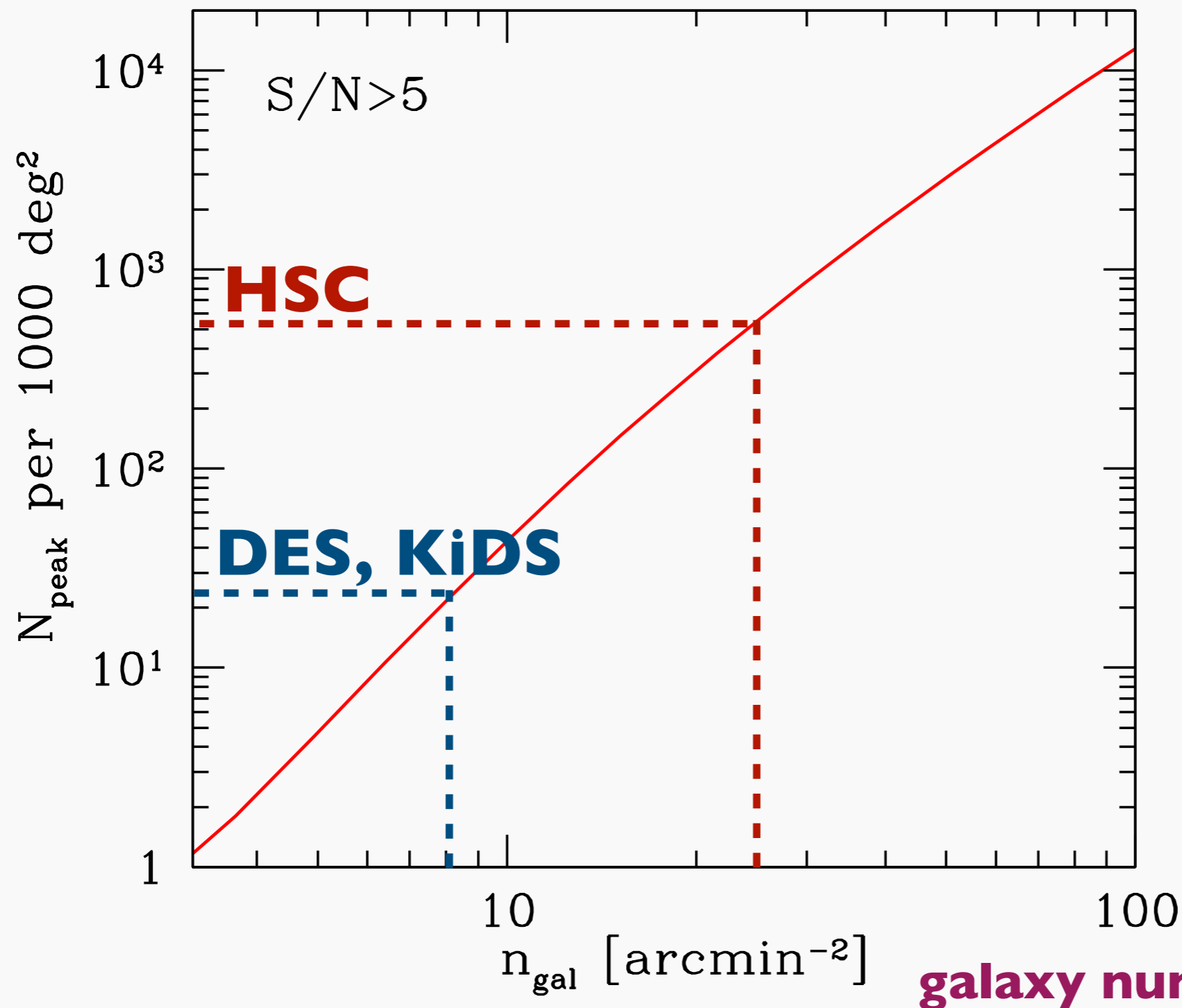


clusters from **peaks** in mass map
[**purely gravitational selection!**]



Depth is important

number density of peaks (clusters)



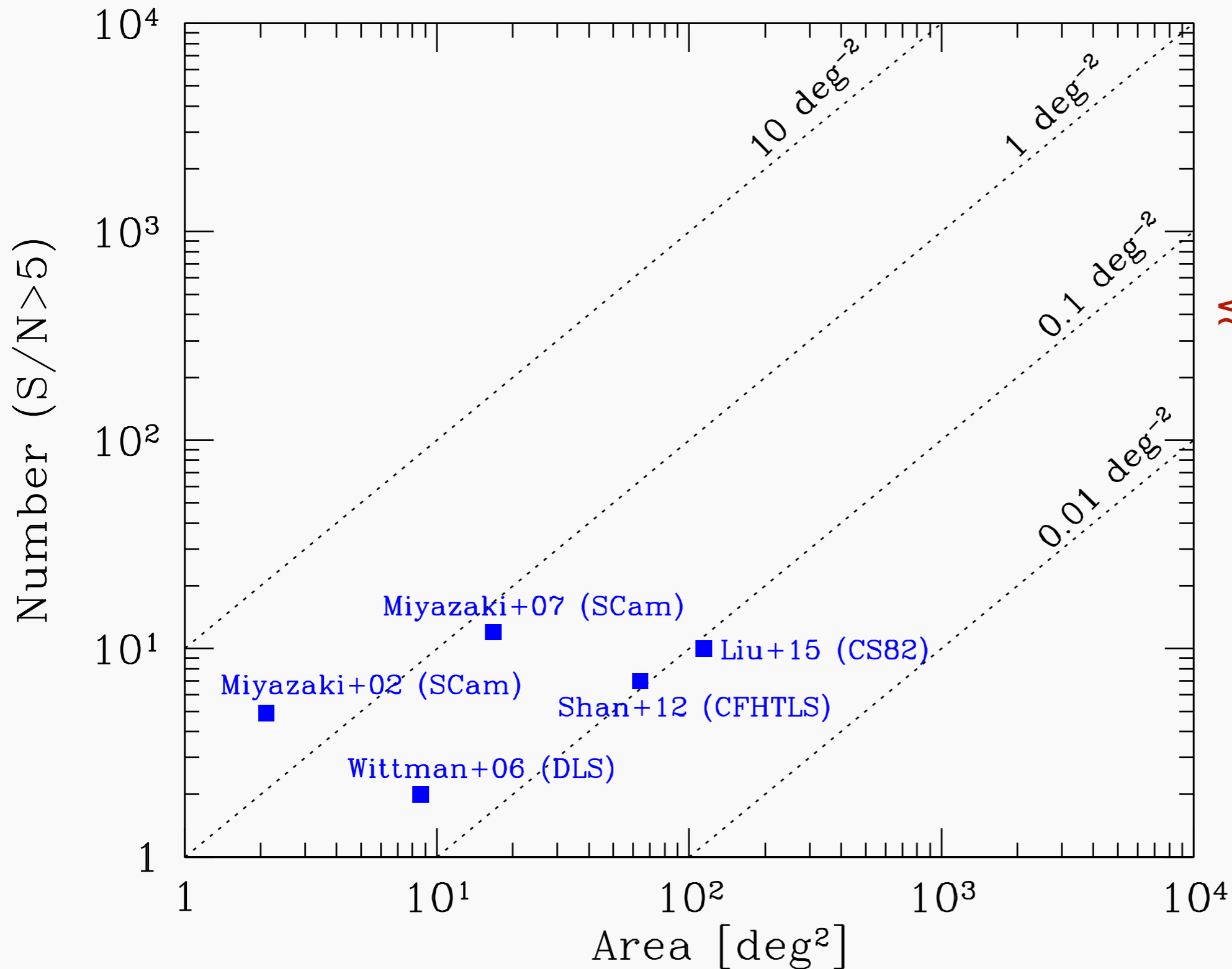
high n_{gal}



high resolution
of mass maps

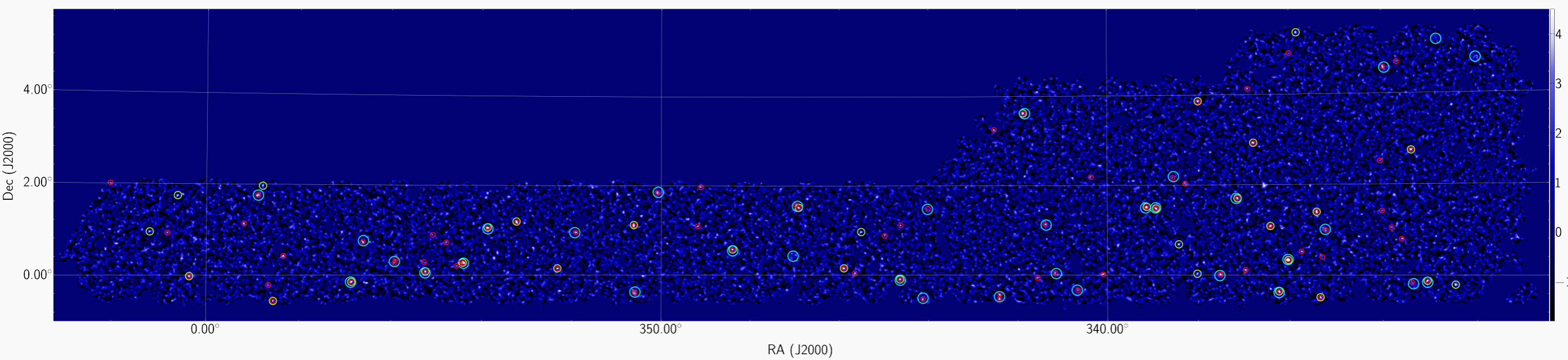
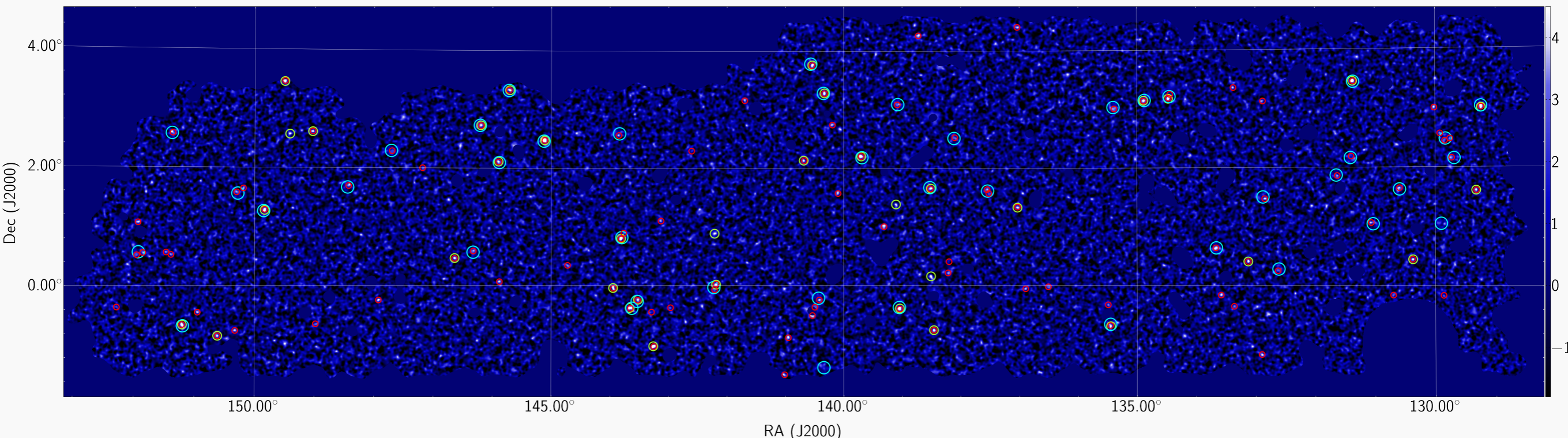
galaxy number density

Challenge: deep *and* wide imaging

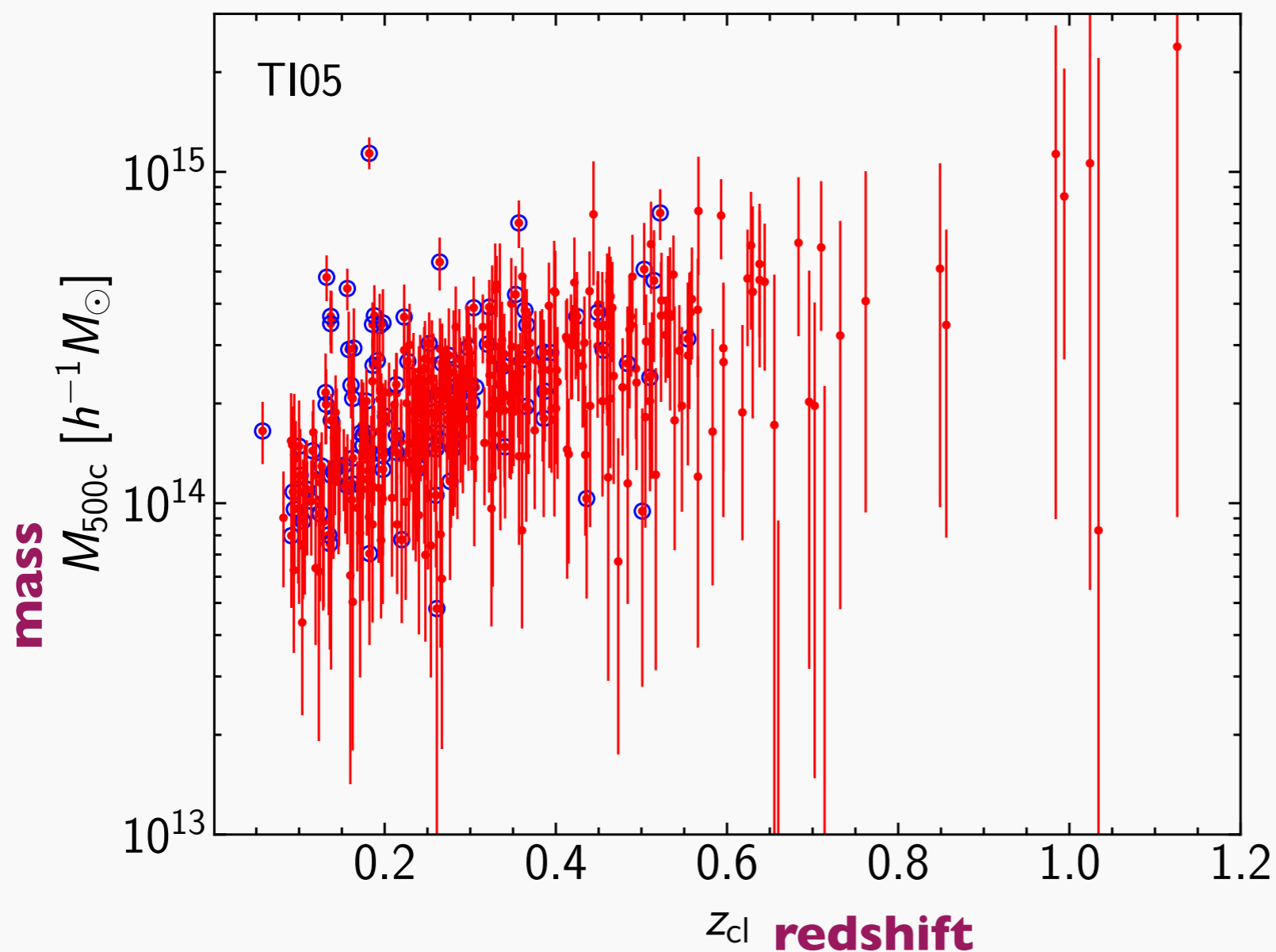


≈ **10 clusters**
before
HSC-SSP

Three year WL selected clusters



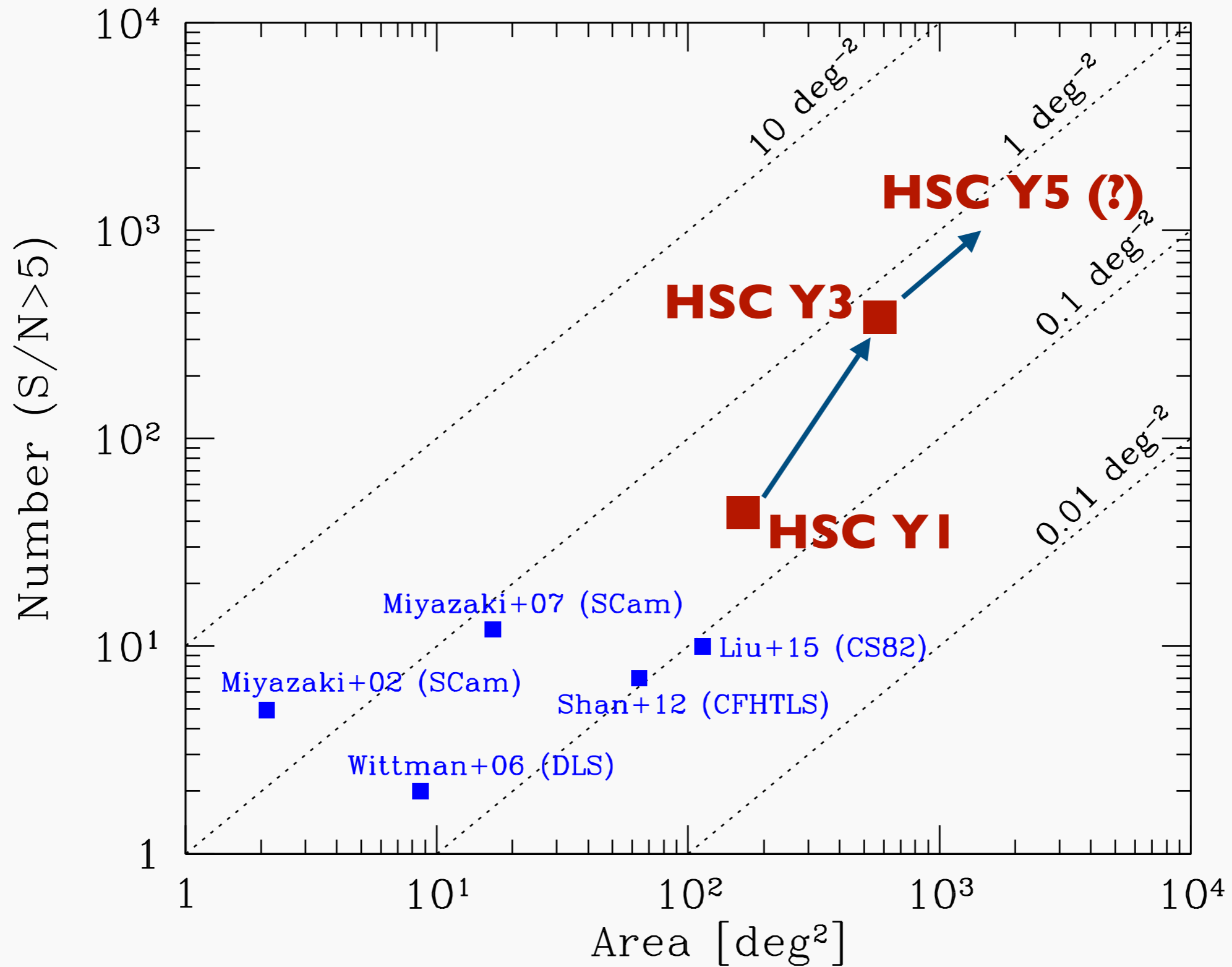
Three year WL selected clusters



418 clusters
with
 $S/N > 4.7$

significantly large
sample for
statistical studies!

WL selected clusters



Applications

- clean and well-understood selection function enables *accurate* cluster cosmology
(talk by **Kai-Feng Chen**)
- testing selection effects of X-ray (eROSITA) selected clusters, and searching for X-ray underluminous clusters
(talk by **Miriam Ramos-Ceja**)

Summary

- unique samples of clusters from HSC-SSP!
- CAMIRA algorithm provides a large homogeneous sample of galaxy-selected clusters out to $z \sim 1$
- HSC-SSP begins to provide a significant sample of weak lensing shear-selected clusters